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Cummings et al.

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[54] **PRODUCTION OF DOUBLE WALL CORRUGATED WEB**

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[73] Assignee: **Marquip, Inc.**, Phillips, Wis.

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[51] **Int. Cl.**[7] **B31F 1/28**

[52] **U.S. Cl.** **156/205**; 156/210; 156/472

[58] **Field of Search** 156/470, 471, 156/472, 473, 205, 210, 207; 428/184, 186, 182; 264/286, 287; 427/211; 493/463

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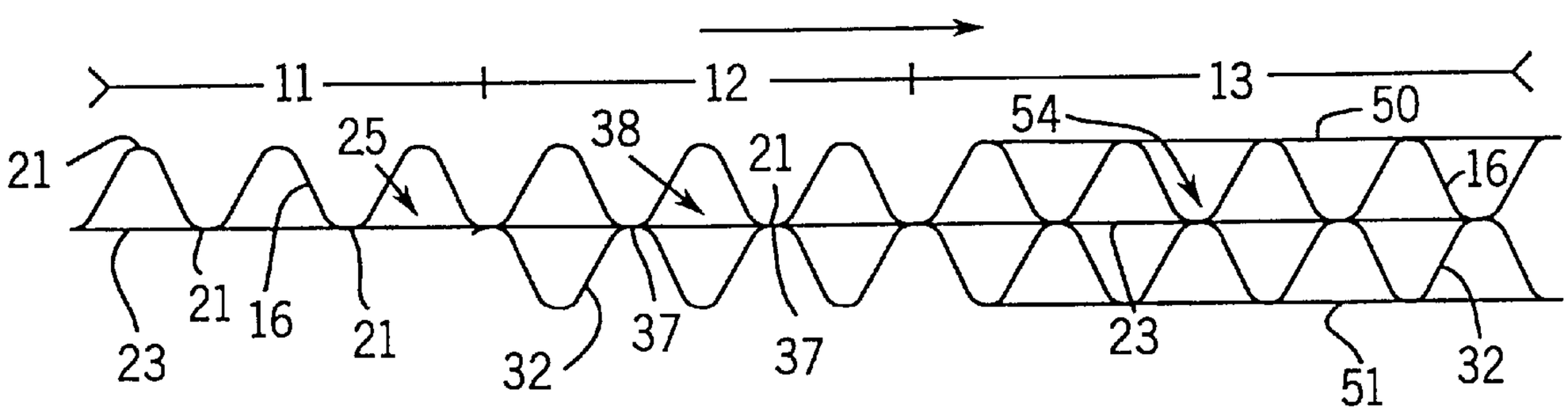
[57] **ABSTRACT**

A synchronized flute double wall corrugated paperboard web is produced in a corrugating apparatus utilizing cooperatively operated single facers to provide an intermediate single face web with corrugated media on both faces, and then combining outer liners to both corrugated media immediately prior to on entry into the double backer utilizing a glue applicator that precludes glue line disturbance. The system may also be operated to produce conventional double wall board or single wall board utilizing either of the single facers. A synchronized flute double wall board provides enhanced strength and may be run on this corrugator at the same speed as single wall board.

14 Claims, 3 Drawing Sheets



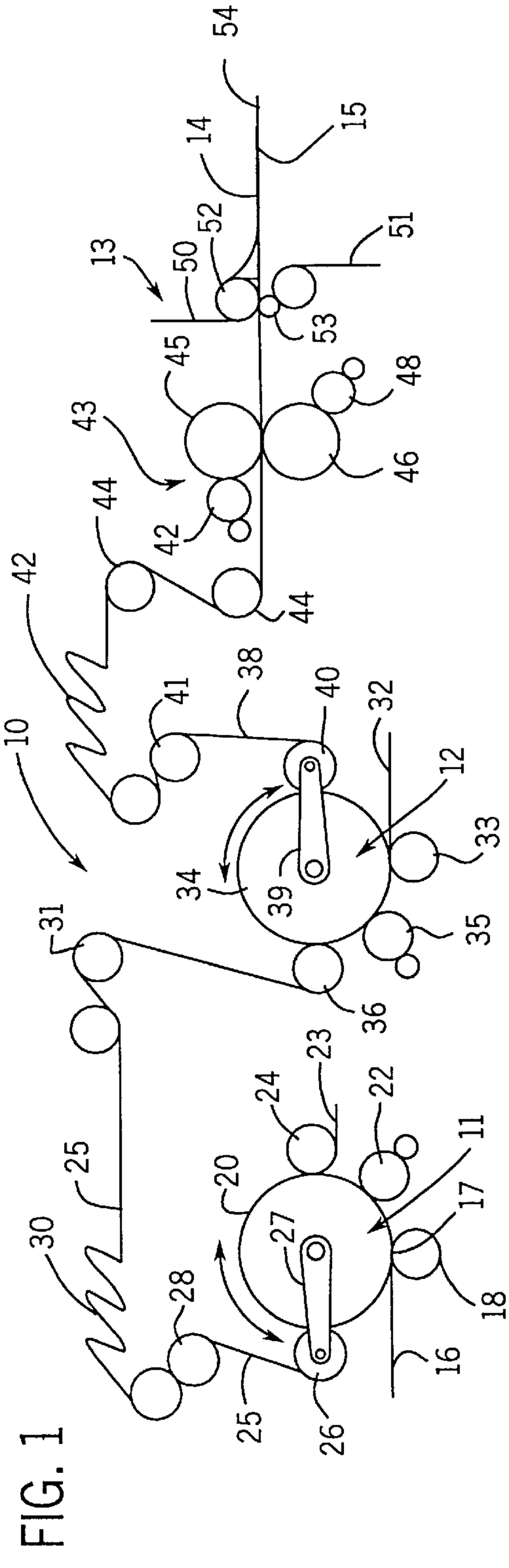

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FIG. 1

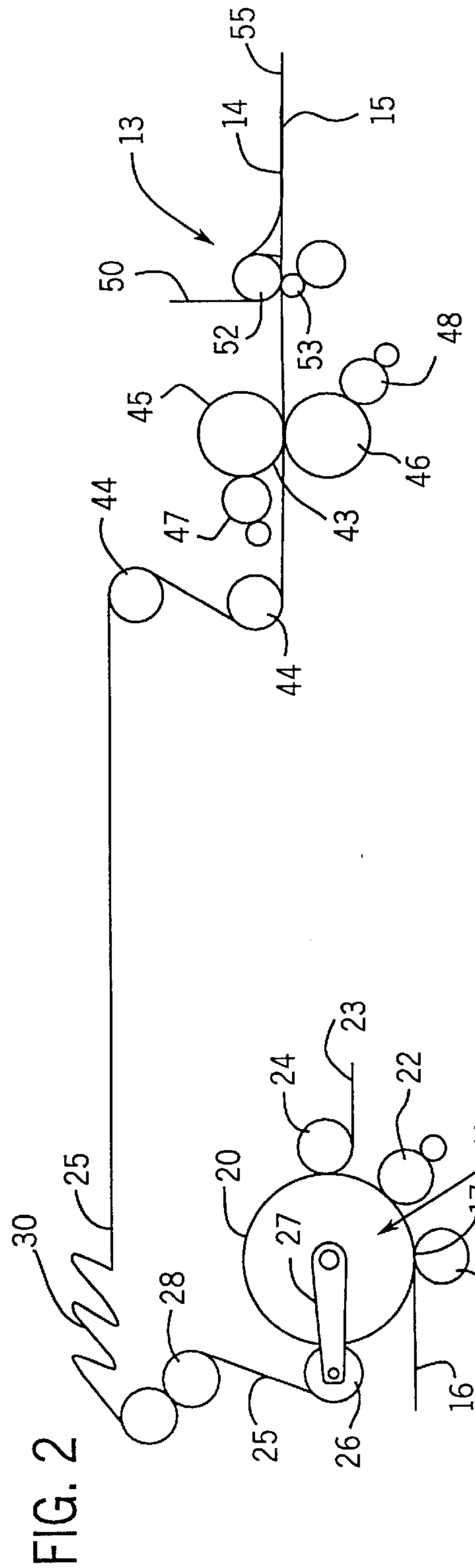
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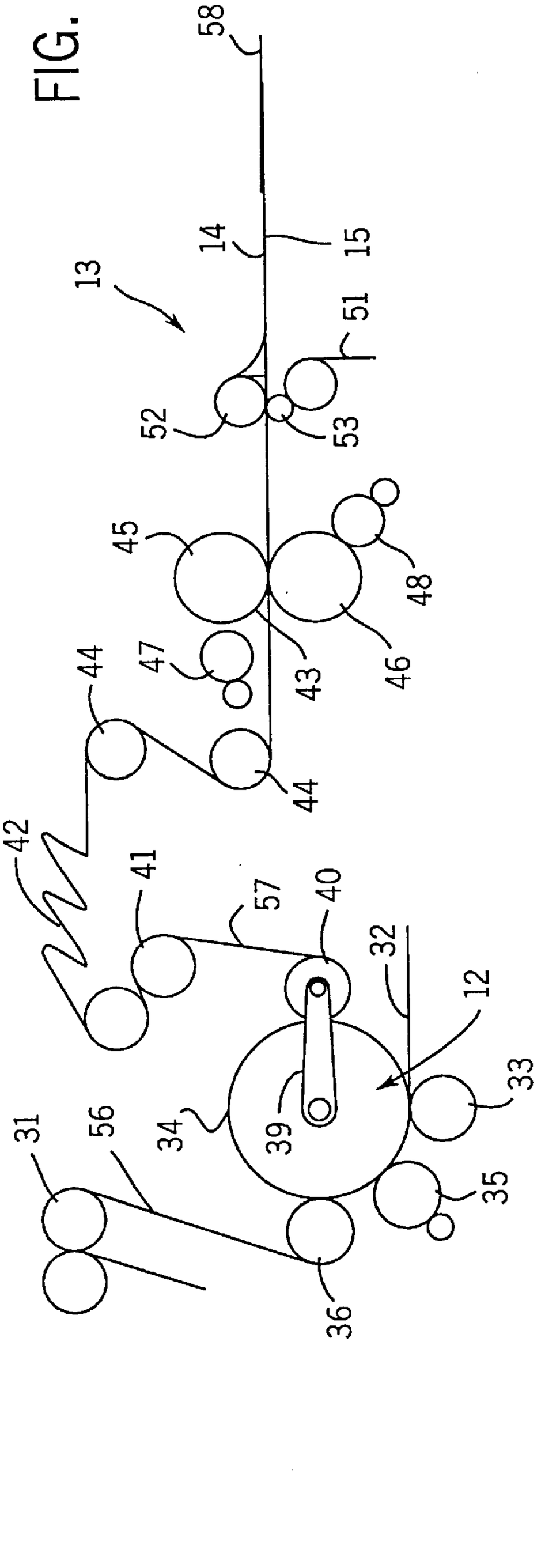
FIG. 2

FIG. 3



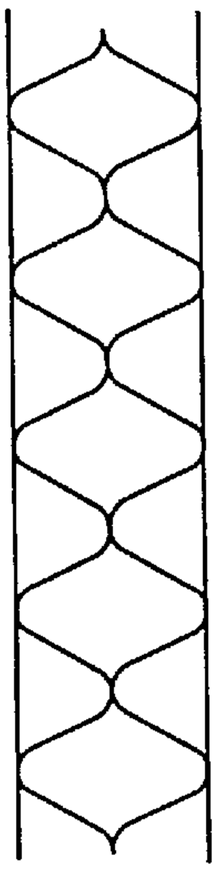


FIG. 5
PRIOR ART

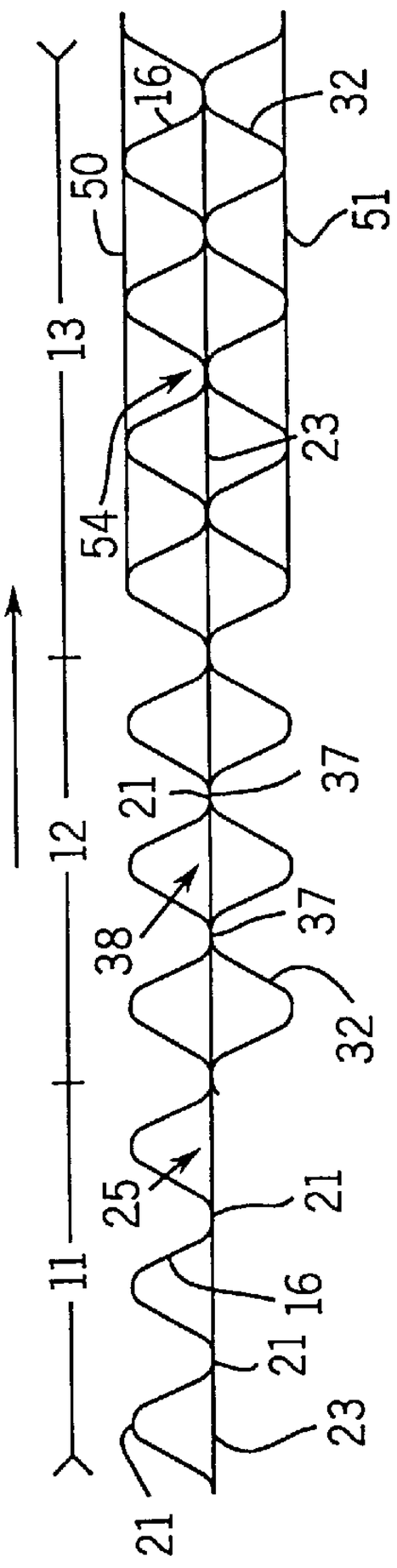


FIG. 4

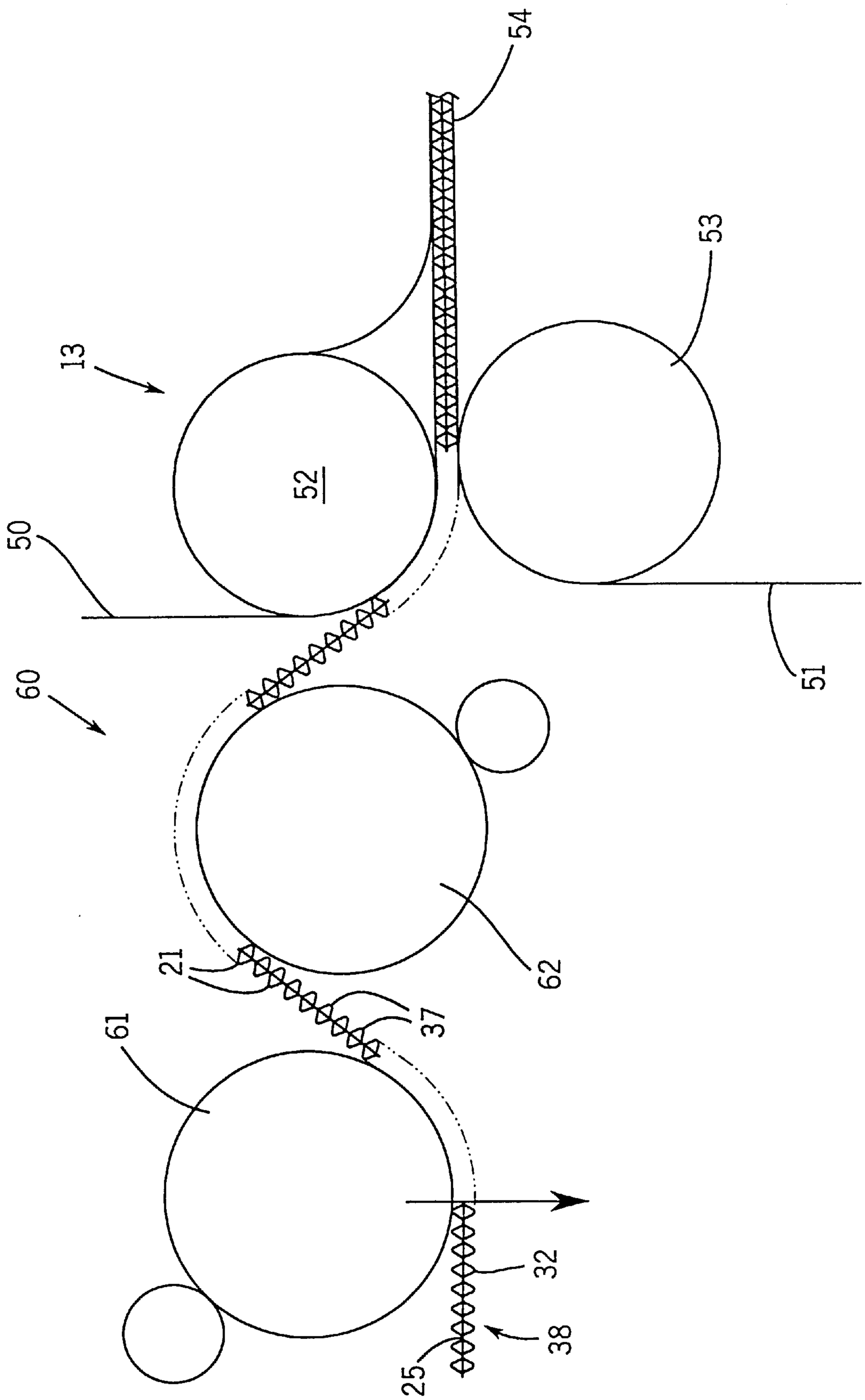


FIG. 6

PRODUCTION OF DOUBLE WALL CORRUGATED WEB

BACKGROUND OF THE INVENTION

The present invention pertains to the production of composite corrugated webs, such as paperboard, and more particularly to the production of double wall corrugated paperboard web in which the flutes of the corrugated medium webs are synchronized and aligned flute-to-flute.

Single wall and double wall corrugated paperboard webs have traditionally been made in a corrugator utilizing, respectively, a basic two stage and three stage process. For single wall board, a single face web, comprising a corrugated medium web and a liner web, are formed in a single facer. In the second stage, the single face web is transferred to a double backer where a second liner web is glued to the exposed corrugated medium web flute tips of the single face web and is passed through a heating section to cure the adhesive and complete the single wall web. Production of conventional double wall corrugated board typically utilizes a second intermediate single facer to produce another single face web in a second stage of the production process. In the third stage, the second single face web is adhesively attached by its liner web to the exposed glued flute tips of the first single face web and, simultaneously, the final (usually lower) liner web is brought into contact with the exposed glued flute tips of the second single face web, and the assembled webs are transported through the heating section of a double backer to provide a final adhesive cure and form the double wall corrugated web.

Typically, in the manufacture of double wall corrugated board, the two single face webs are joined without regard to alignment or synchronization between the flutes in the corrugated media of the two webs. Indeed, often the two single facers produce corrugated webs in which the pitch length of the flutes is different and, therefore, no alignment or synchronization is possible.

However, another type of double wall corrugated web is produced in which the intermediate liner web is eliminated, the flutes on the two facing single face webs are aligned, synchronized, and glued together flute tip-to-flute tip. The device for producing this type of double wall corrugated board is shown, for example, in U.S. Pat. No. 4,935,082. It has been suggested that such double wall corrugated board may be produced with a strength equivalent to conventional double wall board with an additional saving in paper by eliminating the intermediate liner web. However, the production of this modified double wall corrugated web is very slow by today's corrugating standards and cannot be produced at speeds greater than about 425 feet per minute (fpm).

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a high speed corrugator for the production of double wall corrugated paperboard web in which flute-to-flute synchronization between the two single face webs is provided, but without eliminating the intermediate liner web. The corrugating system may also be utilized to produce single wall web utilizing either of the two component single facers, or conventional double wall web.

The corrugating apparatus of the present invention comprises a single facer which produces a first corrugated medium web and adhesively joins it to one face of an intermediate liner web to provide a first single face web. A second single facer produces a second corrugated medium web and adhesively joins it to the other face of the intermediate liner web (from the first single facer) to provide an intermediate single face web in which the first and second corrugated medium webs are joined to the respective opposite faces of the intermediate liner web. The intermediate single face web (having exposed flute tips on both sides) is directed into a double backer where first and second outer liner webs are adhesively joined to the respective first and second medium webs of the intermediate single face web to provide a corrugated double wall web.

Preferably, the second single facer includes a synchronization device which aligns the flute tips of the first and second corrugated medium webs, such that said flute tips, when joined to the opposite faces of the intermediate liner web, are directly aligned. In a presently preferred embodiment, the first and second single facers include fluted corrugating rolls which provide flutes of identical pitch length in each of the corrugated medium webs. The synchronization device comprises a fluted timing roll which carries the initial single face web into joining contact with the second corrugated medium web on the fluted corrugating roll of the second single facer, with said fluted timing roll controlled to provide flute-to-flute register with the fluted corrugating roll of the second single facer. Alternately, the corrugating roll of the first single facer may be provided with a flute pitch length slightly shorter than the flute pitch length of the second single facer corrugating roll. In this embodiment, the synchronization device comprises a tensioning roll which carries the initial single face web into joining contact with the second corrugated medium web on the fluted corrugating roll of the second single facer, said tensioning roll also applying a tension to the intermediate liner web sufficient to stretch the web by an amount equal to the difference in flute pitch lengths between the first and the second corrugating rolls. The pitch length differential may be up to about 0.4%.

The double backer preferably includes upper and lower heating devices which provide direct contact heating to the first and second outer liner webs. In the preferred embodiment, each of the first and second single facers includes a corrugating nip which is defined in part by a large diameter heated fluted corrugating roll around a substantial portion of the circumference of which the respective adhesively joined medium and liner webs are wrapped to provide a selected level of adhesive bond strength.

A unique glue applicator includes two glue rolls which are positioned to apply glue to the exposed flute tips of the respective first and second corrugated medium webs immediately prior to web entry into the double backer such that the freshly glued exposed flute tips are contacted only by the respective first and second outer liner webs, thereby avoiding disturbance of the glue lines prior to web joinder. In one embodiment of the glue applicator, the glue rolls have their axes of rotation substantially aligned in a common vertical plane to apply glue to the exposed flute tips of the respective first and second medium webs simultaneously. In another embodiment, the glue rolls are spaced in the direction of web movement such that glue is applied to the exposed flute tips of the respective first and second medium webs sequentially. In addition, the glue rolls of this embodiment are positioned to cause the intermediate single face web to be wrapped on the glue rolls in a serpentine path to provide web tension sufficient to transfer glue to the exposed flute tips.

In accordance with the method of the present invention, a double wall corrugated web is made utilizing the steps of: forming a first corrugated medium web and adhesively joining said first medium web to one face of an intermediate

liner web in a first single facer to provide an initial single face web; forming a second corrugated medium web and adhesively joining said second medium web to the other face of said intermediate liner web in a second single facer to provide an intermediate single face web having said first and second corrugated medium webs joined to the respective opposite faces of said liner web; and, adhesively joining first and second outer liner webs to the respective first and second medium webs of the intermediate single face web in a double backer to provide the double wall corrugated web. The method preferably includes the step of synchronizing the flute tips of the first and second corrugated medium webs such that said flute tips, when joined to the opposite faces of the intermediate liner web, are directly aligned.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic side elevation view of a corrugating apparatus incorporating the subject invention.

FIG. **2** is a schematic side elevation view of the corrugator of FIG. **1** as operated to produce a single wall corrugated web.

FIG. **3** is a schematic side elevation view of the corrugator shown in FIG. **1** in an alternate mode of operation for the production of a single wall corrugated web.

FIG. **4** is an enlarged side elevation view showing the sequence of formation of double wall corrugated web produced in the corrugating apparatus of FIG. **1**.

FIG. **5** is an enlarged side elevation view of a section of double wall corrugated web formed in accordance with a prior art apparatus and method.

FIG. **6** is an enlarged schematic side elevation view of an alternate embodiment of the glue applicator for the double backer.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A corrugating apparatus **10** of the present invention is shown schematically in FIG. **1**. The corrugator **10** is uniquely adaptable to produce timed flute tip double wall corrugated web in which the flute tips of the two corrugated media are directly aligned or synchronized, conventional double wall corrugated web, or at least two different flute versions of single wall corrugated web. The corrugator **10** includes an upstream first single facer **11**, an intermediate second single facer **12**, a glue machine **43** and a downstream double backer **13**. Each of the single facers **11** and **12** are preferably constructed in accordance with the teaching of U.S. patent application Ser. No. 09/044,516 of C. R. Marschke. However, as will be described hereinafter, the first single facer **11** may be of a conventional prior art construction. The glue machine includes two back-to-back glue applicator rolls that also act as rider rolls for each other in simultaneously applying glue to the top and bottom sides of the single face web. The double backer **13** includes an upper heating unit **14** and a lower heating unit **15**. The upper heating unit **14** may be constructed in accordance with the teaching of U.S. patent application Ser. No. 08/697,768 of C. R. Marschke or U.S. patent application Ser. No. 09/056,537 of C. R. Marschke et al. The lower heating unit **15** may comprise a conventional prior art double backer hot plate system, but preferably comprises a lightweight, fast response hot plate system of the type shown in U.S. Pat. No. 5,766,409. The foregoing patent applications and patent are incorporated herein by reference.

The basic construction and operation of the corrugator **10** will now be described with reference to FIG. **1** and operating in a mode to produce double wall corrugated web with synchronized and directly aligned flute tips. A schematic view of such a double wall web showing the production sequence, is shown in FIG. **4** to which reference will be made from time to time. In the first single facer **11** a first corrugated medium web **16** is formed in a nip **17** between a small diameter lower fluted corrugating roll **18** and a much larger diameter upper fluted bonding roll **20**. The bonding roll **20** is also internally heated. Glue is applied to the exposed flute tips **21** of the first corrugated medium web **16** carried on the bonding roll **20** by a glue applicator roll **22**. A first intermediate liner web **23** is brought into contact with the glued flute tips of the medium web **16** around a contact generator roll **24** that does not make contact with the bonding roll **20**. The resultant first single face web **25** is wrapped on the bonding roll **20** where an initial adhesive green bond is formed sufficient to maintain integrity of the single face web **25** for movement downstream in the corrugator. In accordance with the teaching of the co-pending patent applications identified above, the circumferential portion of the bonding roll **20** around which the first single face web **25** is wrapped may be varied to suit conditions by adjusting the rotational position of a wrap roll **26** attached to a wrap arm **27**. Web tension in the liner web **23** is created by the generator roll **24** and a high coefficient of friction vacuum pull roll **28**. The resulting first single face web **25** has the flute tips of the corrugated medium web **16** pointing upward as it is conveyed downstream in the corrugator **10**. The first single face web **25** may initially be directed into a first bridge storage **30** in a manner well known in the art.

As the first single face web **25** leaves the bridge storage **30**, it is pretensioned by passage around a high coefficient of friction capston roll **31**, from which the web is introduced into the second single facer **12**. In the second single facer, a second medium web **32** is corrugated between a lower corrugating roll **33** and a large diameter upper bonding roll **34** in the same manner as in the first single facer **11**. The flute pitch lengths in the first and second corrugated medium webs are the same. Glue is applied to the flute tips of the second corrugated medium web **32** by glue applicator roll **35**. The first single face web **25** passes around a fluted generator/timing roll **36**, the flute tips of which match the flute pattern of the single face web **25**. The generator/timing roll **36** preferably includes an internal vacuum source communicating with the fluted surface to draw the single face web **25** into intimate contact. The generator roll **36** creates or maintains tension in the web **25** and directs the intermediate liner web **23** into contact with the glued flute tips **37** of the second corrugated medium web **32** traveling on the upper bonding roll **34**. The fluted generator roll **36** is connected by an adjustable gear system (not shown) to the upper bonding roll **34** and is adjusted to be driven to bring the flute tips **21** of the first corrugated medium web **16** into synchronization and direct alignment with the flute tips **37** of the second corrugated medium web **32** on the bonding roll **34** (the corrugated medium webs **16** and **32** being separated by the intermediate liner web **23**, as may be seen in FIG. **4**). The resultant intermediate single face web **38**, comprising the first and second corrugated medium webs **16** and **32** adhesively affixed by their respective inner flute tips to opposite faces of the intermediate liner web **23**, is wrapped around a selectively variable circumferential portion of the heated upper bonding roll **34** by a fluted idler wrap roll **40** on wrap arm **39**, in a manner similar to operation of the wrap roll **26** of the first single facer. From the fluted wrap roll **40**, the intermediate single face web **38** continues around a downstream fluted vacuum pull roll **41**, driven to create

tension in the single face web **38** upstream to the generator/timing roll **36**. This tension is important to maintain intimate contact between the single face web **38** and the fluted surface of the heated bonding roll **34**.

The intermediate single face web **38** may be transferred to a second bridge storage **42** or may continue directly to a downstream glue applicator **43** after travel around a pair of spaced idler rolls **44** which may be fluted or smooth. The downstream idler roll **44** orients the single face web **38** to move horizontally into the glue applicator **43**. Glue is metered onto the surface of upper and lower glue applicator rolls **45** and **46**, respectively, by doctor rolls **47** and **48**. Thus, glue is simultaneously applied to the exposed flute tips **21** and **37** of the corrugated media **16** and **32**, respectively, of the intermediate single face web **38**. Immediately downstream from the glue applicator **43**, an upper first outer liner **50** and a lower second outer liner **51** are brought into contact with the exposed glued flute tips of intermediate single face web **38** by upper and lower delivery rolls **52** and **53**, respectively, and from which the freshly assembled double wall corrugated web **54** is directed into the double backer **13**. The double backer heats the web **54** from the top using the upper heating unit **14** and from the bottom using the lower heating unit **15**. The respective upper and lower heating units **14** and **15** are preferably of a type described in the above identified co-pending U.S. patent applications. The ability to heat the web from both above and below in the double backer **13** permits curing of the adhesive at high speeds, far in excess of the speeds at which prior art synchronized flute double wall board could be produced and at speeds substantially in excess of production speeds for conventional double wall board.

In a slightly modified construction and operation of the corrugator **10**, the first single facer **11** is provided with modified corrugating rolls **18** and **20** formed to provide a flute pitch length just slightly shorter (e.g. 0.3%) than the flute pitch length provided by the second single facer **12**. A pitch length variation up to about 0.4% may be used. For this purpose, a conventional prior art single facer could be used in lieu of the first single facer **11**, although the well formed flutes provided by single facer **11** are preferable. The first single face web **25** formed with the slightly shortened pitch length flutes is carried downstream to the second single facer **12** as previously described. The generator timing roll **36** and the fluted vacuum pull roll **41**, between which tension on the intermediate single facer web **38** is created, are formed with flute patterns identical to that of the second single facer bonding roll **34**, i.e. normal pitch length. Sufficient tension is applied to the joined intermediate single face web on the upper bonding roll **34** to stretch the intermediate liner web **23** and increase the pitch length in the flutes of the first corrugated medium web **16** to match the pitch length of the second corrugated medium web **32** on the upper bonding roll **34**. Otherwise, the generator/timing roll **36** is geared to the bonding roll and adjusted to provide precise alignment between the flute tips **21** and **37** of the respective corrugated media **16** and **32** as previously described. The increased web tension required to restore full pitch length to the intermediate liner web **23** provides a supplemental hoop stress loading against the bonding roll **34** to provide even more intimate contact and enhanced curing of the adhesive, without imposing any detrimental crushing load on the flute tips of either corrugated medium.

An advantage of the glue applicator **43** is that glue may be applied to the exposed flute tips of the corrugated medium webs **16** and **32** on both sides of the intermediate single face web **38** in a manner precluding any subsequent disturbance of the freshly applied glue lines prior to entry of the glued single face web into the double backer **13**. Further, the vertical alignment and superposition of the upper and lower glue applicator rolls **45** and **46** allows the glue to be applied simultaneously such that each applicator roll also acts as the back-up rider roll for the other applicator roll. In FIG. **6**, there is shown an alternate embodiment of a glue applicator **60** in which the first applicator roll **61** is positioned upstream of the second applicator roll **62** with respect to the direction of movement of the intermediate single face web **38**. Further, the first and second applicator rolls **61** and **62** are positioned so that the web **38** is wrapped in a serpentine path on the rolls. With this glue applicator embodiment, the freshly glued exposed flute tips are not subject to any disturbing contact prior to entry into the double backer **14**, as with the previously described embodiment. In addition, the serpentine wrap of the web on the applicator rolls provides sufficient web tension to assure proper glue transfer from the roll to the exposed flute tips. Tension may be varied by adjusting the relative positions of the rolls **61** and **62**.

Referring now to FIG. **2**, the corrugating apparatus of the present invention is shown in a mode of operation to produce conventional single wall corrugated web utilizing the first single facer **11**. In this mode, the second single facer **12** (not shown) is inoperative and the first single face web **25** is directed from the bridge storage **30** directly to the fluted idler roll pair **44** and into the glue applicator **43**. Single face web **25**, when running horizontally into the glue station **43**, is oriented with the corrugated medium web **16** on top to present upper flute tips **21** to upper glue applicator roll **45** which has glue applied to it. Lower glue applicator roll **46** is operated without glue as a conventional rider roll to press the flute tips of the single face web **25** against the glued upper applicator roll **45** with sufficient pressure to facilitate glue transfer to the flute tips **21**. In the double backer **13** the freshly glued single wall corrugated web is cured primarily by operating the upper heating unit **14** to apply heat most directly to the freshly glued flute tips **21** to cure the bond between the top liner **50** and the single face web **25**. The lower heating section **15** is run at a low heating level or even at ambient temperature.

FIG. **3** shows a mode of operation of the corrugator **10** similar to FIG. **2** for the production of single wall board, but utilizing the second single facer **12** in lieu of the first single facer. A top liner **56** is introduced into the second single facer **12** around the capstan roll **31** and is joined to the glued corrugated medium web **32** on the upper bonding roll **34** to create a single face web **57** oriented oppositely from the single face web produced in the first single facer, this single face web **57** having its fluted medium on the lower face of the liner **56**. This may require the use of a non-fluted vacuum pull roll **41** and a non-fluted generator roll **36**, both of which engage the liner web **56**. Such rolls could be changed from the fluted rolls used in the FIG. **1** mode of operation by utilizing a turret changer or other suitable quick roll change means.

In the glue applicator **43**, glue is applied to lower glue applicator roll **46**. Upper glue applicator roll **45** is operated without any glue and in a manner opposite to glue station operation for the FIG. **2** embodiment. Upper applicator roll **45** is operated as a conventional rider roll to press the lower flute tips of the single face web **57** against the lower glue applicator roll **46**. A lower liner **51** is introduced to the glued single face web **57** and the resultant single wall web **58** is introduced into the double backer **13**. The lower heating unit is heated to a temperature sufficient to cure the bond between the single face web **57** and the bottom liner **51**, while the

upper heating unit **14** is controlled to provide a low level of heat or no heat at all, in the latter mode acting simply as a weight system to hold the component webs together and enhance heat transfer from the lower heating unit **15**.

Conventional double wall corrugated web may be run on the corrugating system **10** in a manner nearly identical to the synchronized flute double wall process shown and described with respect to FIG. **1**. However, the generator/timing roll **36** does not have to be operated to provide flute-to-flute synchronization between the two corrugated media **16** and **32**. The resultant intermediate single face web **38**, having non-synchronized flutes, is conveyed to the glue applicator **43** and formed and cured in the double backer **13** to provide double wall web in the same manner previously described. Of course, the flute types as between the first and second single facers may be changed as desired to provide conventional double wall board of any varying flute patterns.

Referring also to FIGS. **4** and **5**, the corrugator **10** of the present invention permits the production of double wall corrugated board similar to the prior art board of FIG. **5**, except that the FIG. **4** double wall of the present invention includes the intermediate liner web **23** between the glued flute tips **21** and **37**, which intermediate liner is absent in the prior art construction of FIG. **5**. The use of the center liner web **23** adds a significant amount of fiber to the double wall board which might seem to be an unnecessary disadvantage over the prior art FIG. **5** board. However, the use of single facers **11** and **12** of the preferred construction, providing lower pressure bonding on a large diameter bonding roll (**20** and **34**), permits the production of an intermediate single face web **38** with such well-formed flutes that it is possible to reduce the fiber content in the medium webs **16** and **32** in an amount equal to a lightweight intermediate liner **23**. The result is believed to be an increased strength-to-weight ratio. The use of an intermediate center liner **23** also makes precise timing and synchronization of the flute tips less critical to the final strength of the board than in the prior art FIG. **5** web. Finally, the corrugator **10** of the present invention, utilizing the preferred component parts as described, is capable of running timed flute double wall board at speeds in excess of 1300 fpm (6.6 meters per second). Because the glue lines on the flute tips **21** and **37** are in contact with their respective outer liners **50** and **51** that are indirect contact with the upper and lower heating units **14** and **15**, heat transfer and adhesive curing are greatly enhanced. As a result, a synchronized flute double wall corrugated web **54** may be run as fast as a single wall board **55** or **58**.

A fundamental advantage of the synchronized flute double wall board **54** of FIG. **4** over a conventional synchronized flute double wall of FIG. **5** is the improvement in flexural stiffness and flat crush strength for equivalent combined board basis weight. In addition, special flute profiles may be developed to take advantage of the process of the present invention to optimize strength to fiber weight ratios of the resultant corrugated paperboard.

We claim:

1. An apparatus for making corrugated web comprising:

a first single facer for producing a first corrugated medium web and adhesively joining said first medium web to one face of an intermediate liner web to provide a first single face web;

a second single facer for producing a second corrugated medium web and adhesively joining said second medium web to the other face of said intermediate liner web to provide an intermediate single face web having said first and second corrugated medium webs joined by inner flute tips to the respective opposite faces of said intermediate liner web and having exposed flute tips on both sides of said liner web;

each of said first and second single facers comprises a corrugating nip defined in part by a large diameter heated fluted corrugating roll around a substantial portion of the circumference of which the respective adhesively joined medium and liner webs are wrapped to provide a selected level of adhesive bond strength;

a glue applicator for applying glue to the exposed flute tips on both sides of said intermediate single face web; and,

a double backer for adhesively joining first and second outer liner webs to the exposed glued flute tips of the respective first and second medium webs of said intermediate single face web to provide a corrugated double wall web.

2. The apparatus as set forth in claim **1** and further comprising:

a synchronization device for aligning the inner flute tips of the first and second corrugated medium webs such that said flute tips joined to the opposite faces of said intermediate liner web are directly aligned.

3. The apparatus as set forth in claim **2** wherein said first and second single facers include fluted corrugating roll providing flutes of identical pitch length in each of said corrugated medium webs, and wherein said synchronization device comprises a fluted timing roll in flute-to-flute register with said fluted corrugating roll of the second single facer for carrying said first single face web into joining contact with said second corrugated medium web on the fluted corrugating roll of the second single facer.

4. An apparatus for making corrugated web comprising:

a first single facer for producing a first corrugated medium web and adhesively joining said first medium web to one face of an intermediate liner web to provide a first single face web;

a second single facer for producing a second corrugated medium web and adhesively joining said second medium web to the other face of said intermediate liner web to provide an intermediate single face web having said first and second corrugated medium webs joined by inner flute tips to the respective opposite faces of said intermediate liner web and having exposed flute tips on both sides of said liner web;

said first and second single facers having fluted corrugating rolls;

said first single facer corrugating roll having a flute pitch length slightly shorter than the flute pitch length of the second single facer corrugating roll;

a synchronization device for aligning the inner flute tips of the first and second corrugated medium webs such that said flute tips joined to the opposite faces of said intermediate liner web are directly aligned, said synchronization device including a tensioning roll for carrying said initial single face web into joining contact with said second corrugated medium web on the fluted corrugating roll of the second single facer and for applying a tension to said intermediate liner web sufficient to stretch the same by the amount of the difference in flute pitch lengths between said first and second corrugating rolls;

a glue applicator for applying glue to the exposed flute tips on both sides of said intermediate single face web; and,

a double backer for adhesively joining first and second outer liner webs to the exposed glued flute tips of the respective first and second medium webs of said intermediate single face web to provide a corrugated double wall web.

5. The apparatus as set forth in claim **4** wherein the flute pitch length of the first corrugating roll is up to about 0.4 percent shorter than the flute pitch length of the second corrugating roll.

6. The apparatus as set forth in claim **1** wherein said double backer comprises upper and lower heating devices providing direct contact heating to said first and second outer liner webs.

7. The apparatus as set forth in claim **1** wherein said glue applicator comprises:

first and second glue rolls positioned to apply glue to the exposed flute tips of the respective first and second corrugated medium webs immediately prior to entry of the intermediate single face web into the double backer such that the freshly glued exposed flute tips are contacted only by the respective first and second outer liner webs.

8. The apparatus as set forth in claim **7** wherein said upper and lower glue rolls have their axes of rotation substantially aligned in a common vertical plane to apply glue to the exposed flute tips of said respective first and second medium webs simultaneously.

9. The apparatus as set forth in claim **7** wherein said upper and lower glue rolls are spaced in the direction of web movement to apply glue to the exposed flute tips of said respective first and second medium webs sequentially, said glue rolls positioned to cause the intermediate single face web to be wrapped on said rolls in a serpentine path to provide web tension sufficient to transfer glue to said exposed flute tips.

10. The apparatus as set forth in claim **9** wherein the position of the rolls relative to one another is adjustable to vary the amount of web wrap thereon.

11. A method for making a double wall corrugated web comprising the steps of:

(a) in a first single facer, providing a first corrugating nip defined in part by a first large diameter heated fluted corrugating roll and forming a first corrugated medium web and adhesively joining said first medium web to one face of an intermediate liner web to provide an initial single face web;

(b) wrapping the initial single face web around a substantial portion of the circumference of said first corrugating roll to provide a selected level of adhesive bond strength;

(c) in a second single facer, providing a second corrugating nip defined in part by a second large diameter heated fluted corrugating roll and forming a second corrugated medium web and adhesively joining said second medium web to the other face of the intermediate liner web to provide an intermediate single face web having said first and second corrugated medium webs joined by inner flute tips to the respective opposite faces of said intermediate liner web and having exposed flute tips on both sides of said intermediate liner web;

(d) wrapping the intermediate single face web around a substantial portion of the circumference of said second corrugating roll to provide a selected level of adhesive bond strength;

(e) in a glue applicator, applying glue to the expose flute tips on both sides of said intermediate single face web; and,

(f) in a double backer, adhesively joining first and second outer liner webs to the exposed glued flute tips of the respective first and second medium webs of said intermediate single face web to provide said double wall corrugated web.

12. The method as set forth in claim **11** including the step of synchronizing the inner flute tips of the first and second corrugated medium webs such that said flute tips joined to the opposite faces of said intermediate liner web are directly aligned.

13. An apparatus for making a double wall corrugated paperboard web comprising:

a first single facer having a fluted bonding roll forming a first corrugating nip and a heated bonding surface for producing a first corrugated medium web and adhesively joining said first medium web to one face of an intermediate liner web to provide a first single face web having a desired level of adhesive green bond strength;

a second single facer having a fluted bonding roll forming a second corrugating nip and a heated bonding surface for producing a second corrugated medium web and joining said second medium web to the other face of said intermediate liner web to provide an intermediate single face web having said first and second corrugated medium webs joined by inner flute tips to the respective opposite faces of said intermediate liner web in a manner leaving exposed flute tips on both sides of said liner web, said intermediate liner web having a desired level of adhesive green bond strength;

means for applying glue to said exposed flute tips on both sides; and,

means for joining first and second outer liner webs to the respective first and second medium webs of said intermediate single face web to provide said corrugated double wall web.

14. The apparatus as set forth in claim **13** and further comprising:

synchronization means for aligning the inner flute tips of the first and second corrugated medium webs such that said flute tips joined to the opposite faces of said intermediate liner web are directly aligned.

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